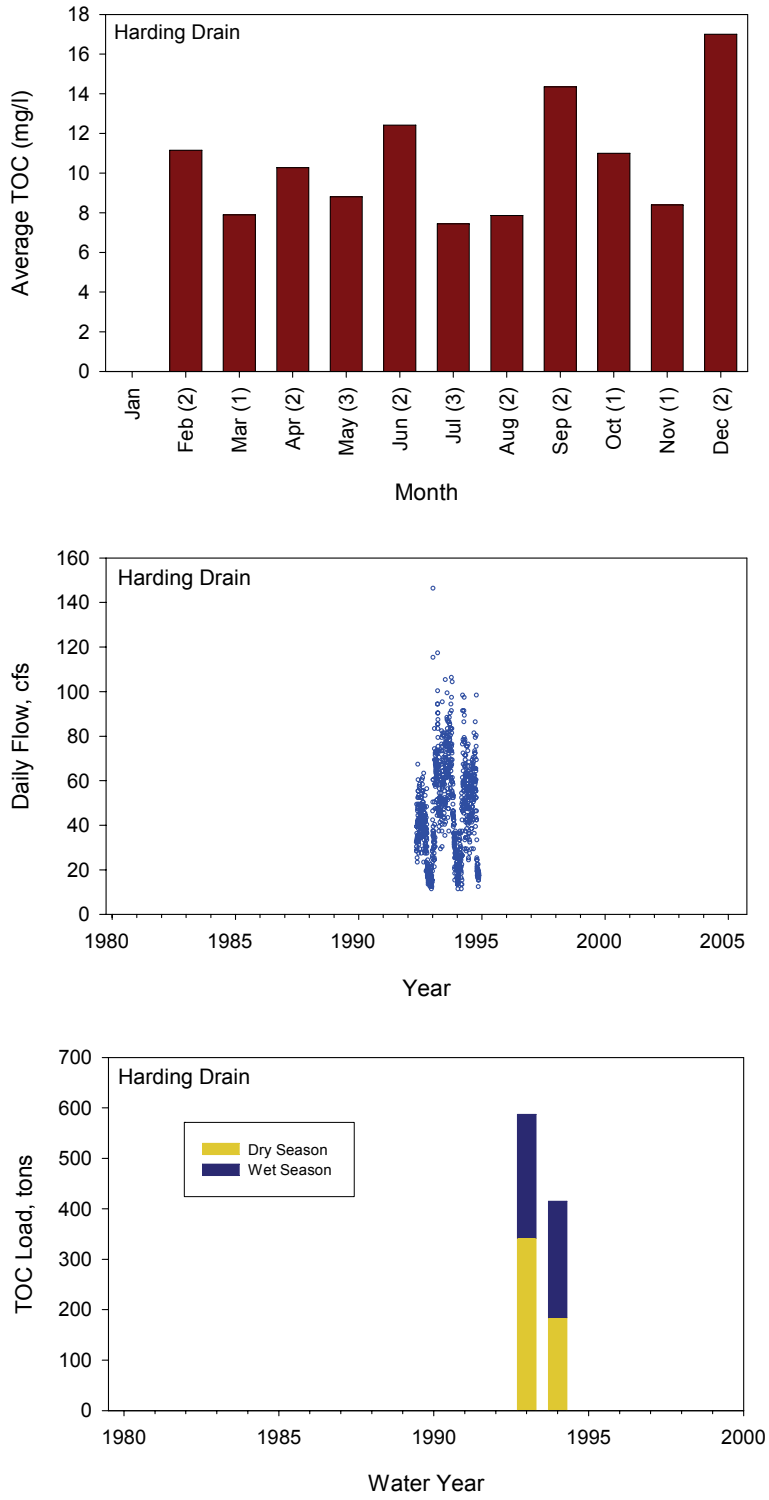


Figure 4-27. Monthly average concentration, daily discharge, and estimated wet and dry season loads by water year for the Harding Drain. These data were used to estimate the organic carbon export rate from agriculture in the San Joaquin River basin.

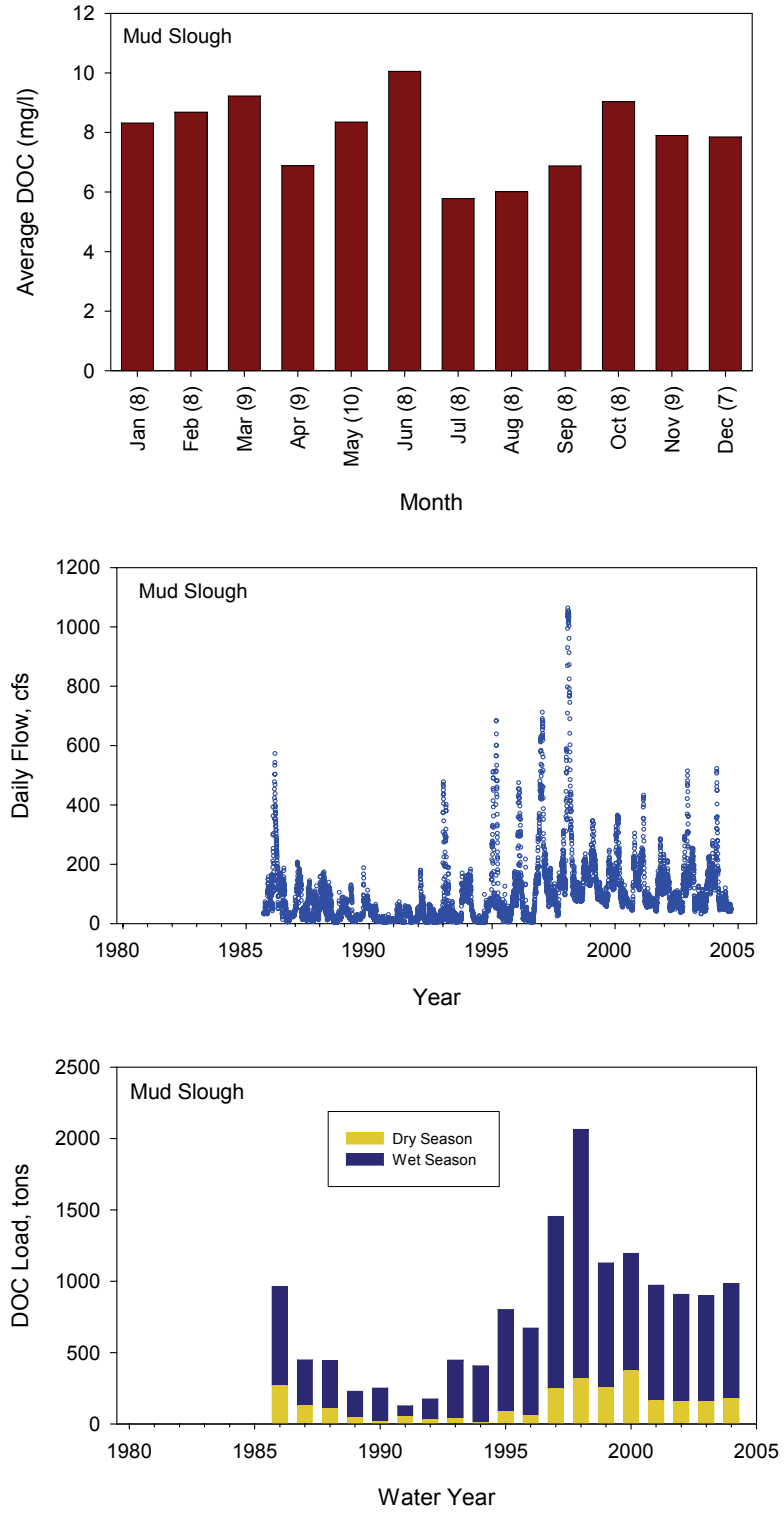


Figure 4-28. Monthly average concentration, daily discharge, and estimated wet and dry season loads by water year for the Mud Slough. These data were used to estimate the organic carbon export rate from wetlands in the San Joaquin basin.

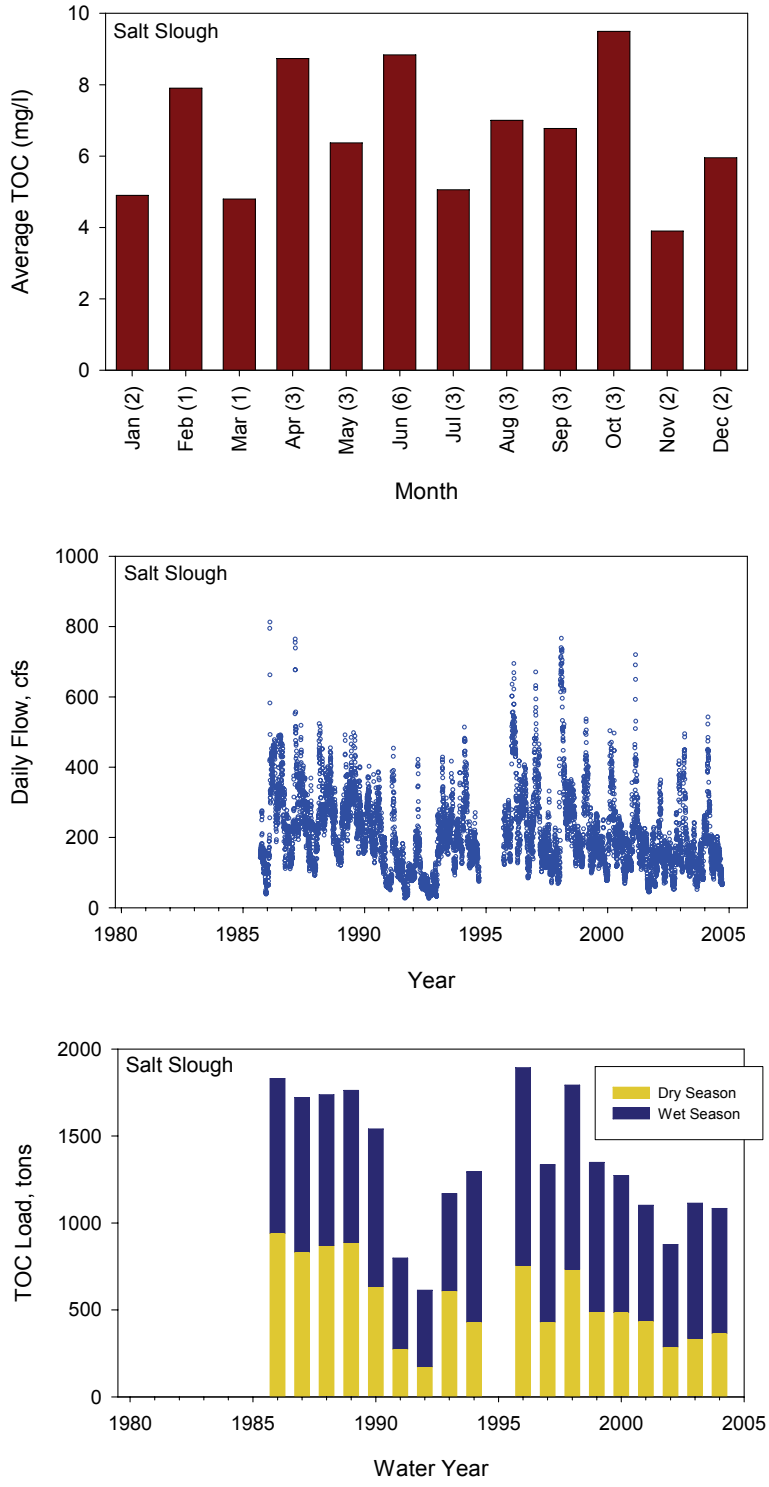


Figure 4-29. Monthly average concentration, daily discharge, and estimated wet and dry season loads by water year for the Salt Slough. These data were used to estimate the organic carbon export rate from wetlands in the San Joaquin basin.

- The urban runoff export rate for organic carbon was estimated using USGS data collected at Arcade Creek (Saleh et al., 2003). Arcade Creek has a small, entirely urban, watershed (Figure 4-30) and is a good choice for the export rate calculation. Data collected at the Natomas East Main Drainage Canal (NEMDC) may also be used for estimating urban runoff loads. Although this watershed is rapidly urbanizing, it still contains some agricultural land. The Arcade Creek watershed was considered the best choice for this analysis since it is an entirely urbanized watershed. Other urban runoff data in the Drinking Water Policy Database from the cities of Sacramento and Stockton could not be used because these data were not accompanied by flow measurements. The urban runoff data from Sacramento, Stockton, and the NEMDC (Figure 4-31) were compared to the data collected on Arcade Creek. NEMDC data were obtained from the MWQI website for the period 1997 to 2004. The monthly average concentrations for TOC in Arcade Creek ranged from 7 to 12 mg/L. The Sacramento and Stockton stormwater TOC data show a great deal of variability with concentrations ranging from 3 to 60 mg/L and with an average concentration of 15 mg/L, somewhat higher than the Arcade Creek data. The NEMDC TOC data vary from 3 mg/l to 50 mg/l with an average concentration of approximately 8 mg/l, comparable to the Arcade Creek data. In general, dry weather concentrations are marginally higher than the wet weather concentrations, although the actual impact on delivered loads may be dominated by relative magnitudes of flow.

- No station could be clearly identified as a background station with insignificant anthropogenic activity. As a first approximation, the Yuba River watershed was used to estimate background loads for the Sacramento River Basin. Of the major tributaries, the Yuba River watershed has the least amount of urban and agricultural land. Although the TOC concentrations are low in the watershed, the occasional high flows result in an export rate virtually identical to that calculated for the Colusa Basin Drain. This may also be an expression of the inapplicability of the Yuba River Watershed for determining background export rates. The Yuba River basin wet and dry year export rates of 1.7 and 0.41 tons/km^2/yr may be compared with an estimate of 0.96 tons/km^2/yr for an relatively undeveloped watershed in the Rocky Mountains (Boyer et al., 2000).

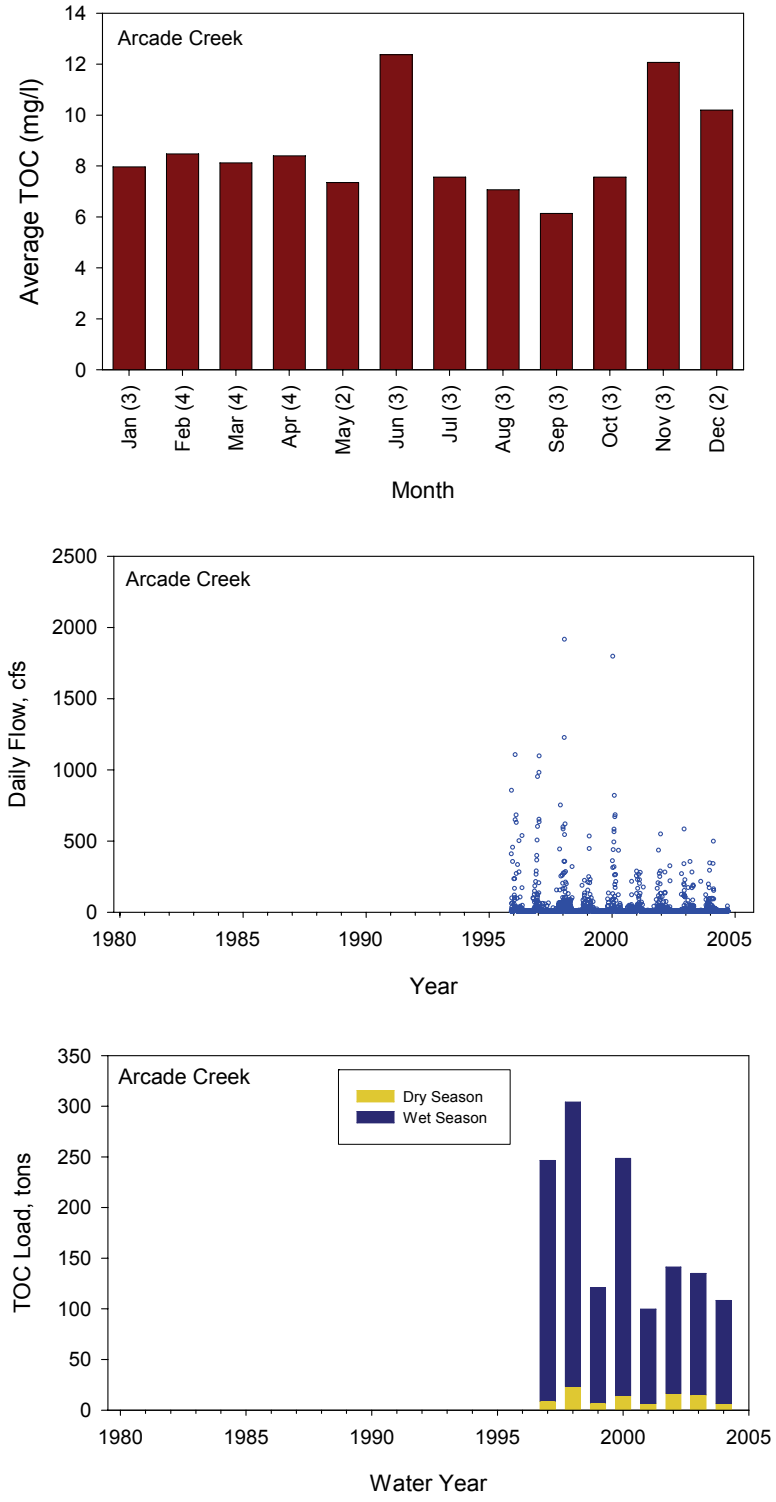


Figure 4-30. Monthly average concentration, daily discharge, and estimated wet and dry season loads by water year for Arcade Creek, used to estimate the urban runoff export rate for organic carbon from the Sacramento River basin.

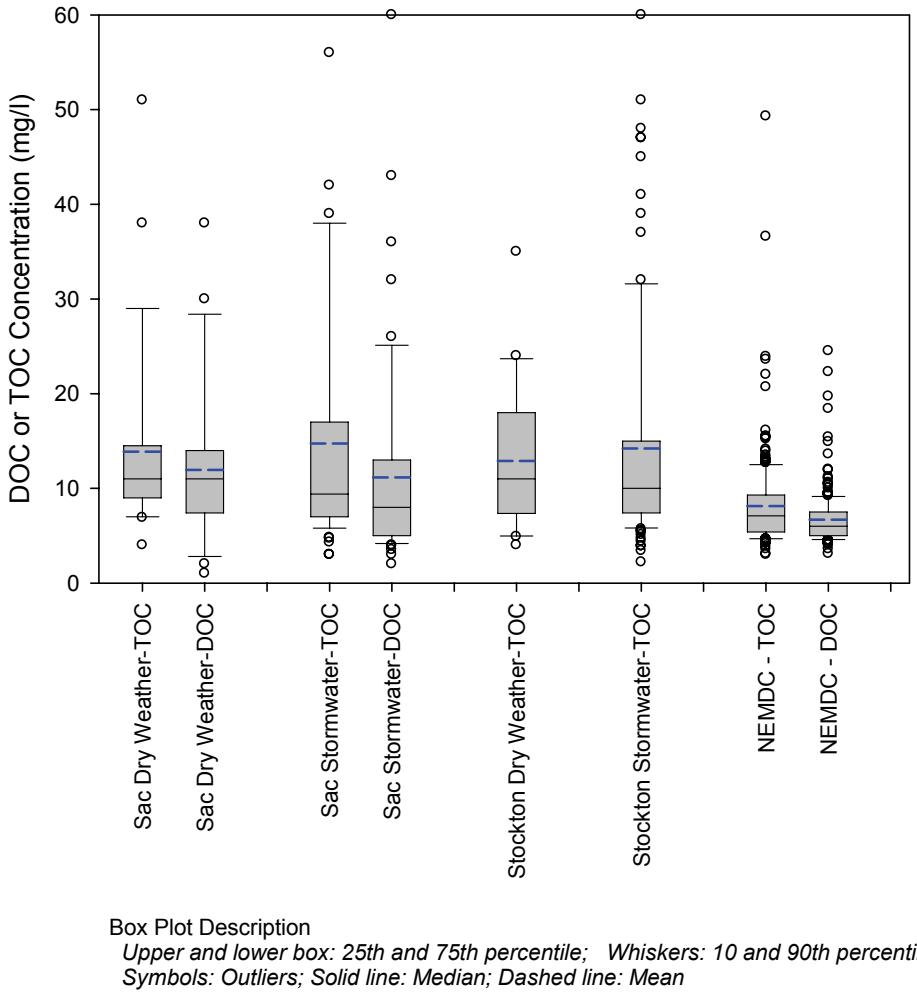


Figure 4-31. Urban runoff organic carbon concentration data from Sacramento, Stockton, and the Natomas East Main Drainage Canal (NEMDC).

The summary of export rates for various land uses in the Central Valley is presented in Table 4-7. Although it would be preferable to obtain separate export rates for the Sacramento and San Joaquin Basins because of the distinct differences in rainfall, this was not possible with existing data. Rainfall during water years 2002 and 2003 measure at three stations in the Sacramento Valley averaged 23.7 inches and measured at three stations in the San Joaquin Valley averaged 11.7 inches (MWQI, 2005), which is a factor of two difference. Therefore, when a rate from the Sacramento Basin was applied to the San Joaquin Basin (for urban runoff and for forest/shrubland), the export rate was divided by two to account for the lower rainfall in the San Joaquin Basin. When a rate from the San Joaquin Basin was applied to the Sacramento Basin (for wetlands), the rate was multiplied by two to account for the higher rainfall in the Sacramento Basin. For agricultural land, separate values were used for the Sacramento and San Joaquin Basins.

Table 4-7.
Export rates of organic carbon from major land uses in the Central Valley.

Land Use	Dry Year Loads (tons/km^2/yr)		Wet Year Loads (tons/km^2/yr)		Source	
	Sac-ramento	*San Joaquin*	*Sac-ramento*	*San Joaquin*	*Sacramento*	*San Joaquin*
Agriculture[1]	0.56	1.9	1.6	2.6	Colusa Basin Drain	Harding Drain[2]
Urban Runoff	1.3	0.67	2.4	1.2	Arcade Creek	Calculated from Sacramento value
Forest/Rangeland	0.41	0.21	1.7	0.85	Yuba River	Calculated from Sacramento value
Wetland-Dominated[3]	1.4	0.69	2.0	1.0	Calculated from San Joaquin value	Average of Salt and Mud Slough

[1]Available data do not allow separation into crop types.

[2]May include a small POTW influence.

[3]Wetland-dominated land may include a portion that is agricultural land.

4.5.2 POINT SOURCES

Point source discharges in the Central Valley watershed include municipal wastewater treatment plants, industries, and fish hatcheries. There are no data on organic carbon concentrations in discharges from fish hatcheries or industries in the watershed. The major municipal wastewater dischargers are shown in Table 4-8 and on Figure 4-32. Municipal wastewater dischargers are not generally required to monitor organic carbon in their effluent as a condition of their National Pollutant Discharge Elimination System (NPDES) permits. Concentration and flow data were available for the cities of Davis and Vacaville, and for the Sacramento Regional Wastewater Treatment Plant, which serves all of the cities and much of the unincorporated urban area of the County of Sacramento (Figure 4-33). TOC concentrations were four times higher at Davis than Vacaville, and concentrations at Sacramento Regional were even higher.

Wastewater effluent concentrations from these three plants do not show any strong seasonal patterns (Figure 4-34) so the average annual concentration was multiplied by the average effluent flow rate to estimate the total load from each plant. The total load was divided by the population served by these wastewater treatment plants (Davis, 60,300; Vacaville, 88,200; Sacramento, 1,128,000), to obtain the TOC load per person per year (1.7, 0.6, and 3.77 kg/year for Davis, Vacaville, and Sacramento, respectively). To obtain the load from urban areas for which no data are available, the urban population in the specified watershed was determined from Census Bureau data, and the population multiplied by an average per person TOC loading of 2 kg/person/year (average of 1.7, 0.6, and 3.77 kg/person/year from the plants above).

Table 4-8.
Wastewater treatment plants in the Central Valley and Delta.

Wastewater Treatment Plant		Treatment	Design Flow (MGD)
Sacramento Basin			
	Sacramento Regional	Secondary	181
	Roseville-Dry Creek	Tertiary	18
	Roseville-Pleasant Grove Creek	Tertiary	12
	Vacaville	Secondary	10
	Chico	Secondary	9
	Redding Clear Creek	Secondary	9
	Woodland	Secondary	8
	West Sacramento	Secondary	8
	Davis	Secondary	8
	Yuba City	Secondary	7
	Redding Stillwater	Advanced Secondary	4
Total Flow to Sacramento			*273*
San Joaquin Basin			
	Modesto	Secondary	70
	Stockton (Nov-Jun)	Secondary	55
	Stockton (July-Oct)	Advanced Secondary	55
	Turlock	Secondary	20
	Merced	Secondary	10
	Manteca	Secondary	10
Total Flow to San Joaquin			*165*
Delta			
	Tracy	Secondary	9
	Lodi	Advanced Secondary	7
	Brentwood	Advanced Secondary	5
	Discovery Bay	Secondary	2
Total Flow to Delta			*23*
Total Watershed Flow			**461**

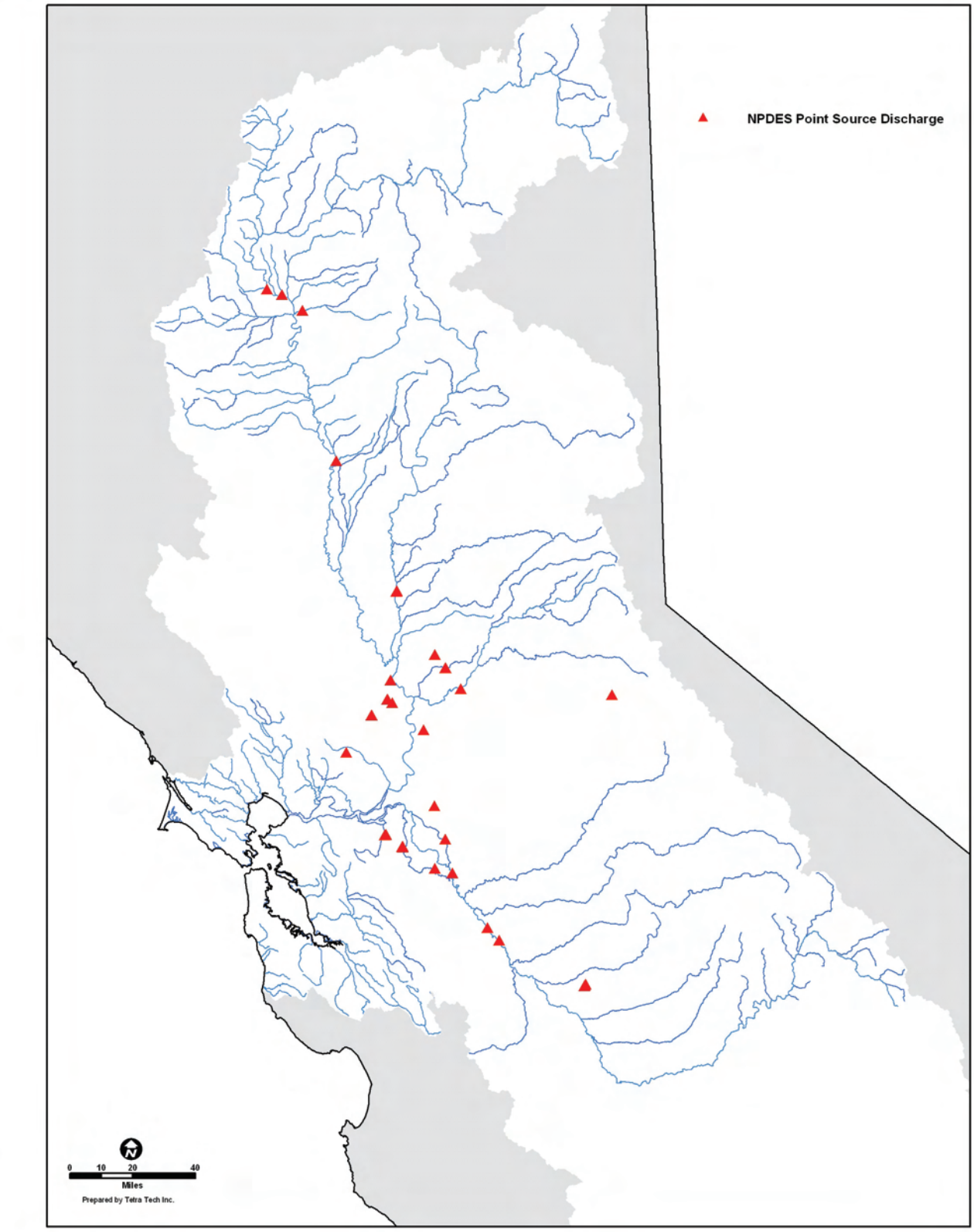
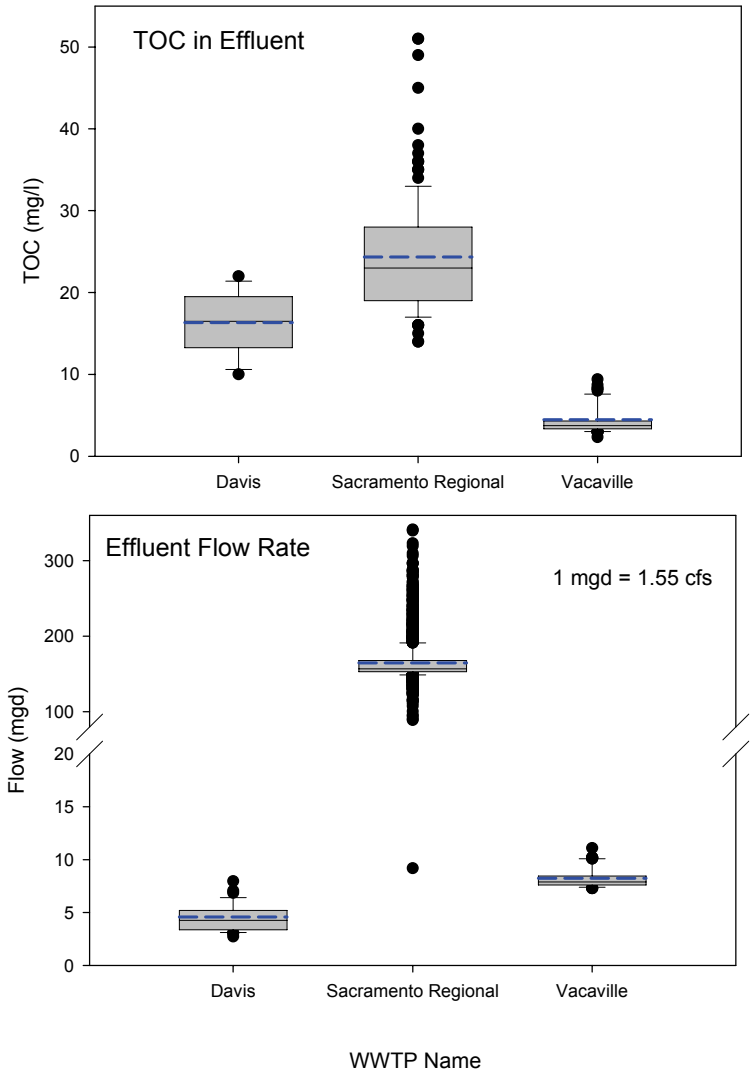


Figure 4-32. Point source discharge locations in the database developed by Central Valley Drinking Water Policy Workgroup.



Box Plot Description
Upper and lower box: 25th and 75th percentile; Whiskers: 10 and 90th percentile
Symbols: Outliers; Solid line: Median; Dashed line: Mean

Figure 4-33. Organic carbon concentration and flow data for Davis, Sacramento, and Vacaville. These are the only point sources that monitor organic carbon in their outflows.